



*Digital Monochrome Quad Speed
CMOS Progressive Scan Camera*

CV-A33CL

Operation Manual

*Camera: Revision A
Manual: Version 1.0*

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1. General

The CV-A33CL is a digital CMOS camera designed for automated imaging applications, featuring high speed within a uniform and compact housing.

The high-speed shutter function, asynchronous random trigger mode and partial scan mode, with window of interest, allows the camera to capture high quality images of fast moving objects with a high frame rate. The CV-A33CL features the Camera Link standardized multiplexed signal output interface.

The latest version of this manual can be downloaded from: www.jai.com

The latest version of Camera Control Tool for CV-A33CL can be downloaded from: www.jai.com

For camera revision history, please contact your local JAI distributor.

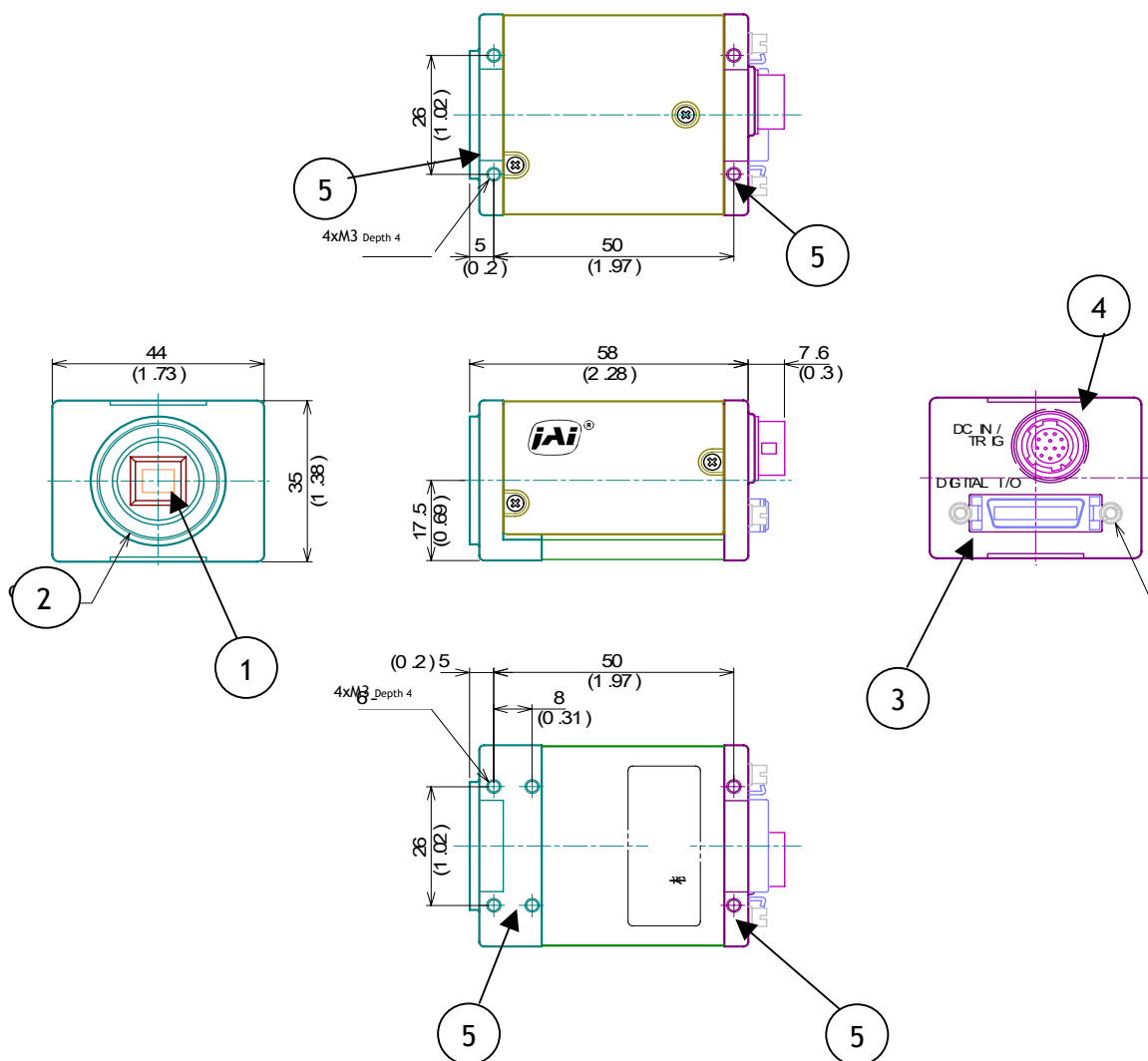
2. Standard Composition

The standard camera composition consists of the camera main body and tripod mount plate.

3. Main Features

- 1/2" progressive scan monochrome CMOS sensor
- 659 (h) x 493 (v) 9.9 μ m square pixels effective
- 10 or 8 bit video output in Camera Link
- 118.4 fps at full resolution
- 4953 frames/second for a 659 (h) x 3 (v) pixel image
- Programmable X and Y origin and size for window of interest
- Edge pre-select and pulse width external trigger modes
- Global shutter for instant full frame exposure
- Programmable shutter from 1 LVAL to 492 LVAL (16.8 μ sec. to 8.3 msec.)
- Auto trigger function based on programmable 659 (h) x n (v) window
- Auto trigger frame rate up to 5403 frames/second
- Accepts standard C-mount lenses
- A-series platform
- Short ASCII commands for fast mode setup via serial port
- Setup by Windows 98/NT/2000 software via RS 232C or Camera Link

4. Locations and Functions



1. CMOS sensor
2. Lens mount (C-mount)
3. Digital output connector (Camera Link)
4. DC in/Trigger in/RS-232C connector
5. Mounting holes M3. Depth 4. (10x)

Fig. 1. Locations

5. Pin Assignment

5.1. 12-pin Multi-connector (DC-IN/Trigger)

Type: HR10A-10R-12PB-01
(Hirose) male.
(Seen from rear of camera.)

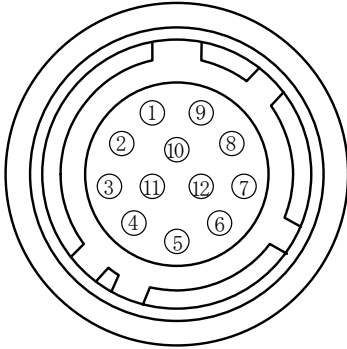
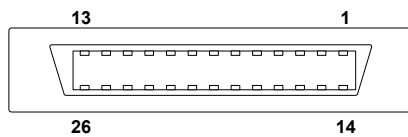


Fig. 2. 12-pin connector.

Pin no.	Signal	Remarks
1	GND	
2	+12 V DC input	
3	GND	
4	N/C	
5	GND	
6	RXD in	RS 232C. Or via Camera Link by internal SW200 on PK8378A (Off=HR)
7	TXD out	
8	GND	
9	EEN out	And via Camera Link
10	Trigger input	Or via Camera Link. (TI=1 for HR) *)
11	N/C	
12	GND	

*) Internal SW300-1 on rear board for 75 Ω terminations.
Refer to 7.1. Inside switch settings.

5.2. Digital Output Connector for Camera Link



Type: 26 pin MRD connector
3M 10226-1A10JL

Fig. 3. Camera Link connector

The digital output signals follow the Camera Link standardized multiplexed signal output interface. Camera Link base configuration is used. The interface circuit is build around the NS type DS90CR285MTD.

The following signals are found on the Digital Output Connector:

SerTC	RXD serial data to camera	(Or via 12 pin HR by internal SW200.
SerTFG	TXD serial data to frame grabber	On for CL)
CC1	Trigger input	(Or on 12 pin HR. TI=0 for CL)
CC2	Factory use	
X0 to X3	Camera Link multiplexed data out	
Xclk	Camera Link clock. Used as pixel clock.	

In the Channel Link X0 to X3 multiplexed signals the following signals are encoded.

D0 - D9	2 x 8/10 bit video data out.
LVAL	Line VALid. Video line data is valid. High for valid line.
FVAL	Frame VALid. Video frame data is valid. High for valid frame.
DVAL	Data VALid. Effective video pixel data is valid. High for valid data.
EEN	Exposure ENable. High during exposure.

The polarity is positive and TRIG in negative as factory setting.
For Camera Link interface principle diagram please check Fig. 7.

5.3. Input and Output Circuits

5.3.1. Trigger input

The trigger inputs on pin #10 12 pin Hirose connector is AC coupled. To allow a long pulse width, the input circuit is a flip flop, which is toggled by the negative or positive differentiated spikes caused by the falling or rising trigger edges.

The trigger polarity can be changed.

Trigger input level $4\text{ V} \pm 2\text{ V}$. It can be 75Ω terminated by internal SW300 on PK8388A.

The trigger inputs can be changed to Camera Link input. (TI=0 for CL)

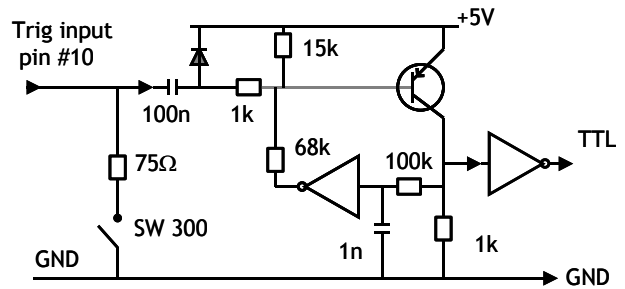


Fig. 4. Trigger input.

5.3.2. EEN output

On pin #9 on 12 pin HR connector EEN The output circuit is 75Ω complementary emitter followers. It will deliver a full 5 volt signal.

Output level $\geq 4\text{ V}$ from 75Ω . (No termination).

EEN is also found in Camera Link.

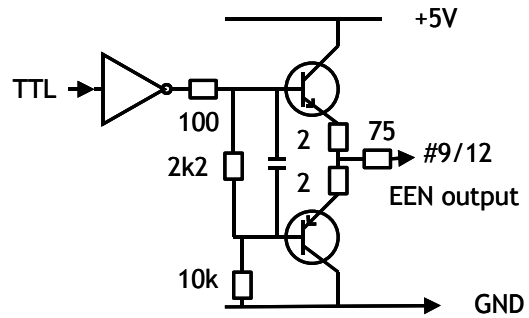


Fig. 5. EEN output

5.3.3. Camera Link interface

The video output is Camera Link with 10 or 8 bit video placed in a base configuration. The digital output signals follow the Camera Link standardized multiplexed signal output interface. The Camera Link output driver is NS type DS90CR285MTD.

The data bits from the digital video, FVAL, LVAL, DVAL and EEN are multiplexed into the twisted pairs, which are a part of the Camera Link. Trigger signals and the serial camera control are feed directly through its own pairs. The trigger input can also be TTL on the 12 pin connector. (TI=0 for CL. TI=1 for 12 pin HR). The serial camera control can be switches between the 12 pin connector or CL by the internal switch SW200 on PK8387B.

The 26 pin MDR connector pin assignment follows the Camera Link base configuration.

For a detailed description of Camera Link specifications, please refer to the Camera Link standard specifications found on www.jai.com

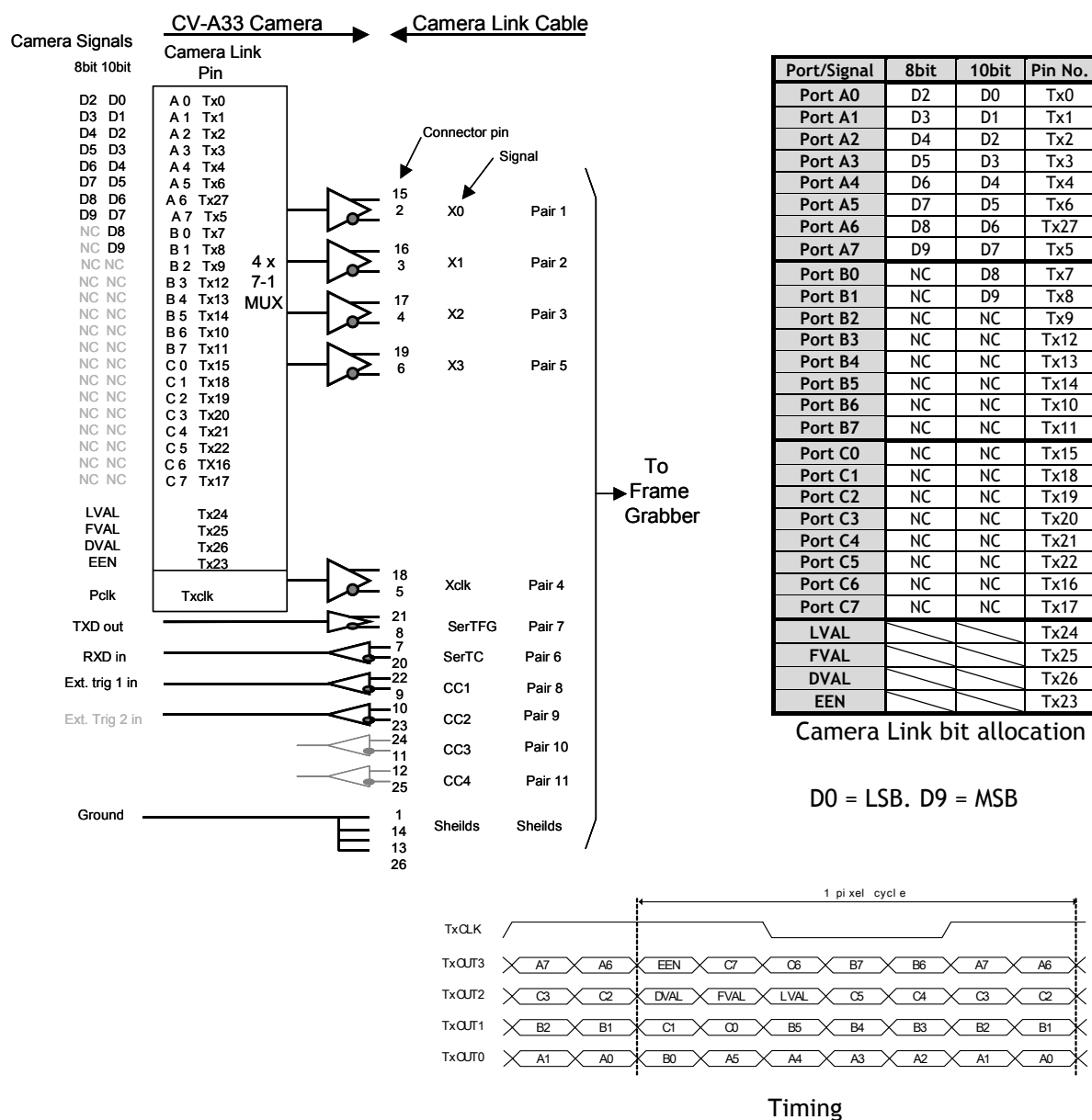


Fig. 7. Principle diagram for Camera Link base configuration interface

6. Functions and Operations

In the following the format shown in "7.3. CV-A33CL command list" are used for function commands and parameters.

6.1. Basic functions

The CV-A33CL camera is a progressive scan camera with 10 or 8 bit video output in single channel Camera Link.

Programmable partial scan, where the start line and the number of lines can be selected with 1 line increment is also available.

There are 4 modes: Normal continuous, and 3 trigger modes: Edge Pre-Select (EPS), Pulse Width Control (PWC) and Auto Trigger.

The accumulation is LVAL a-synchronous.

In the following some of the functions are shown in details.

6.1.1. CMOS Sensor

The CMOS sensor principle layout is shown.

The sensor is an array of active photosensitive pixels. The global shutter is working simultaneously on all pixels. The readout can be random row by row. 4 columns are feed through a 4 to 1 multiplexer to an A/D converter. The digitized row signals are placed in a vertical register by a 1 to 4 multiplexing. From here it is read out with the pixel clock pulses, even if the window of interest has fewer columns. The frame speed depends only of the height of the window, not of the width.

Pixel principle and column processing with A/D converting is shown below.

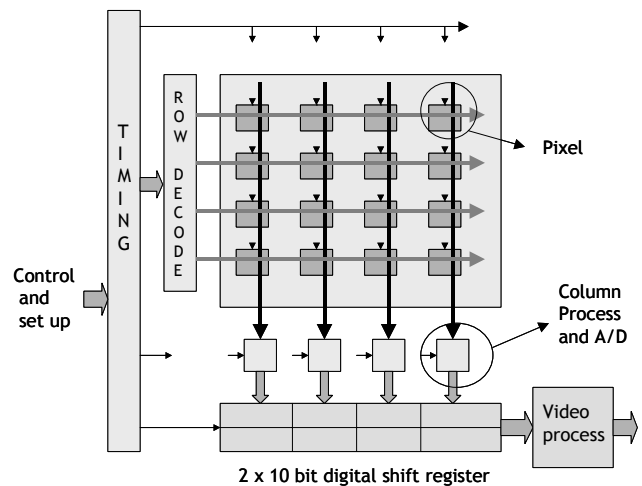


Fig. 7. CMOS principle layout

6.1.2. Pixel principle

Each pixel consists of a sensing part, a pixel memory and an amplifier. The function can in short be described. The photo diode and charge capacitor is reset when switch 1 is closed. The signal accumulation starts when sw 1 open. The charge is transferred to the pixel memory capacitor when sw 2 close. The accumulation stop when sw 2 open, and the signal is now temporary stored in the memory capacitor. After reset of the charge capacitor, a new accumulation can start. The signal on the pixel memory capacitor is read out to the column by the read row signal. The memory can now be reset.

With this construction all pixels will integrate at the same time, (Global shutter). The resulting image is temporary stored in the pixel memory during read out, while a new exposure can be started.

All timing is set up in the timing block by an internal serial link.

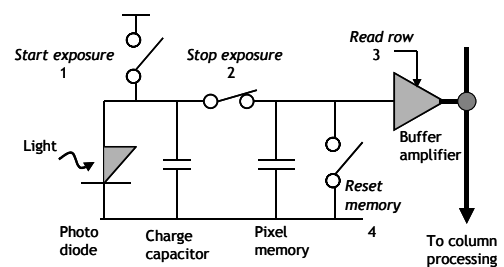


Fig. 8. Pixel principle.

6.1.3. Column Process

The voltage signal from a single pixel is send to the column amplifier trough the 4 to 1 multiplexer. After the S/H circuit, the offset and gain calibrating is perform. A 10 bit A/D converter send the digital pixel signal to the digital horizontal shift register by a 1 to 4 multiplexing. Signals from a single row with 667 pixels are processed in parallel and send to the shift register. Control and timing is done from the timing block.

The calibrate command CB = 0 will start an automatic calibrate routine for offset and gain for all 167 A/D converter. It reduces the vertical fix pattern column noise.

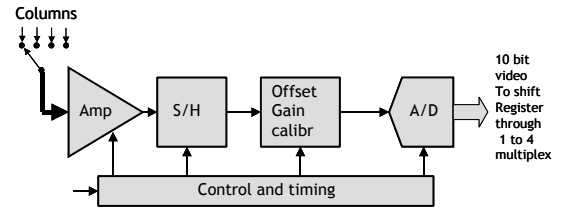


Fig. 9. Column processing principle

6.1.4. CV-A33 CMOS Sensor array

The CMOS sensor total array is 667 (h) x 502 (v). Here the 659 (h) x 494 (v) is active photo sensing pixels. 8 pixels (h) and 8 rows (v) are optical black pixels for internal black level reference. There is an A/D converter for each 4 columns. A 4 to 1 multiplexer feed the signals from 4 columns to a A/D converter. The digital converter output is multiplexed to the 667 x10 bit register.

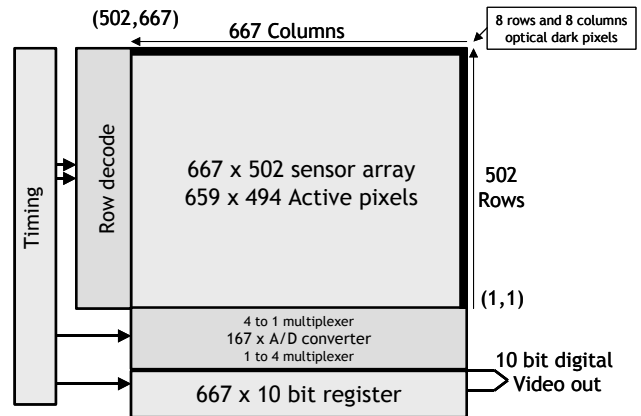


Fig. 10. CV-A33 CMOS sensor array

6.1.5. CMOS Sensor principle diagram

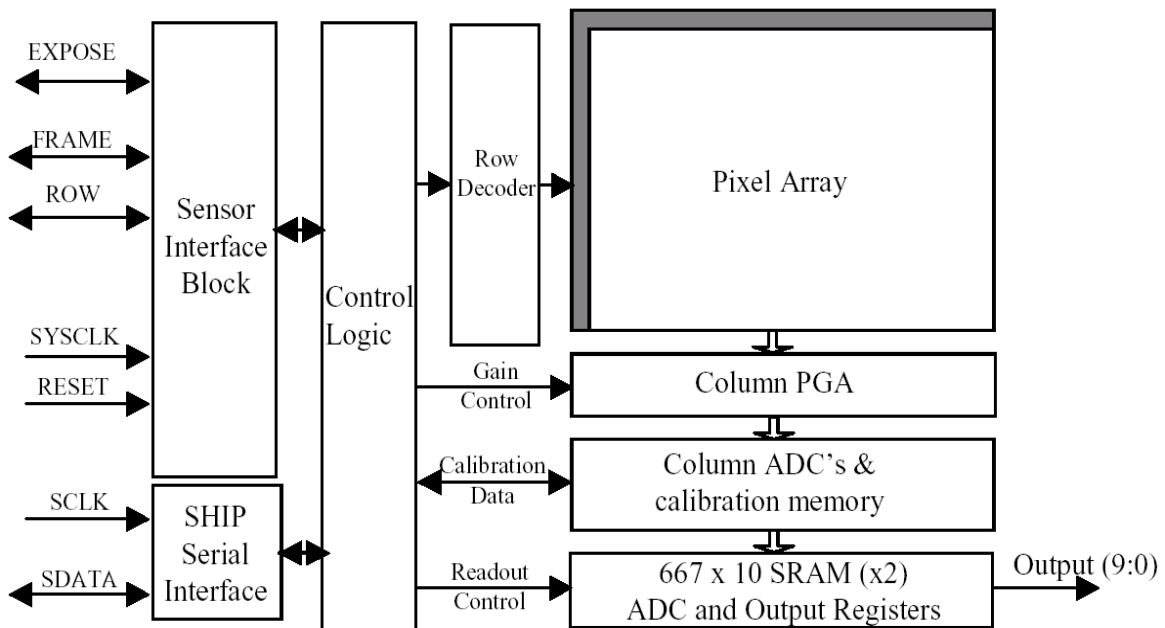


Fig. 11. CMOS sensor principle diagram

6.1.6. Window of Interest

If a higher frame rate is wanted, it is possible to change the CMOS sensors sensing area to the window of interest. WS =1 for windows scan.

The X,Y start coordinate, the window width and height can be programmed.

WX can be in the range 0 to 657

WY can be in the range 0 to 490

WW can be in the range 2 to 659. ($WX + WW \leq 659$)

WH can be in the range 3 to 493. ($WY + WH \leq 493$)

The frame rate will not increase if the width WW is reduced. The horizontal shift register need to be read out in its full length.

Minimum size for the window of interest is 2 (h) x 3 (v) pixels.

Maxim frame rate is 4953 fps.

For DVAL timing details for the window of interest, refer to 6.2.5 fig. 17 through 19.

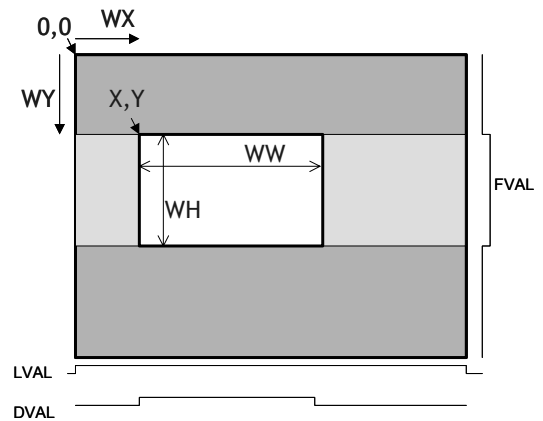


Fig. 12. Windows of Interest

6.1.7. Auto Trigger Window of Interest.

The auto trigger function, TR=3 can be used as sensing device inside the camera field of view.

The scanned area is from top of the image, and the height can be programmed with the command AT= --.

The accumulation time is equal to the number of LVAL programmed with AT.

The minimum height of the window of interest for the auto trigger function is the 3 top lines of the image. The height of the auto trigger window can be programmed in the range AT = 3 to 493. The window is always from the top of image. The read out time is the active number of LVAL + 9 LVAL.

Maxim frame rate is 5403 fps given by the 11 LVAL for a minimum window read out.

(1 LVAL = 16.825 μ sec.)

The connected frame grabber should be programmed to sense if objects passing the window.

The horizontal position and the signal threshold could be the programmed parameters. If an

object passing is detected, a trigger is send to the camera, and a full frame is exposed with the same accumulation time as programmed for AT. The resulting image, a full frame or windows scan, (depending of windows scan setting), is read out to the grabber, and the auto trigger function will start again.

6.2. Sensor layout and timing.

6.2.1. Effective image format

The drawing below shows the effective pixels on the CCD array with respect to pixels and lines as it is used in the timing and video read out.

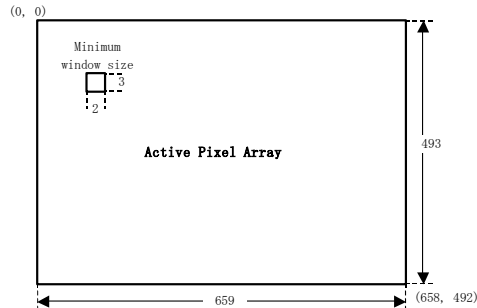


Fig. 13. Effective image layout

6.2.2. Vertical timing

Normal mode. Full frame.

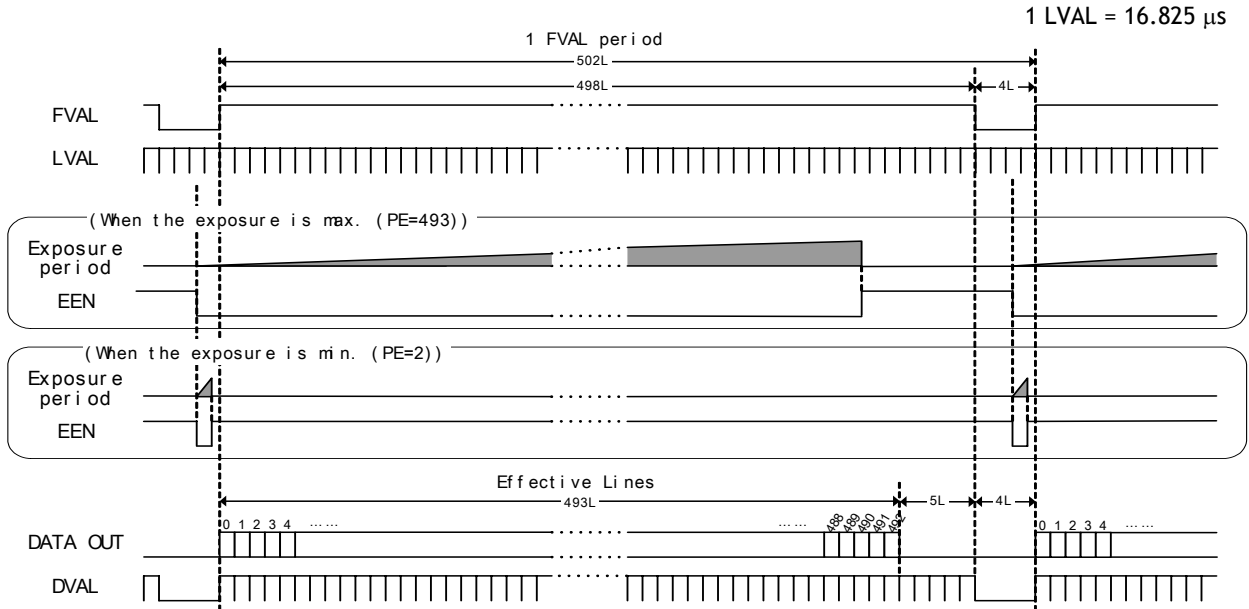


Fig. 14. Vertical timing

6.2.3. Horizontal timing

Normal mode. Full frame.

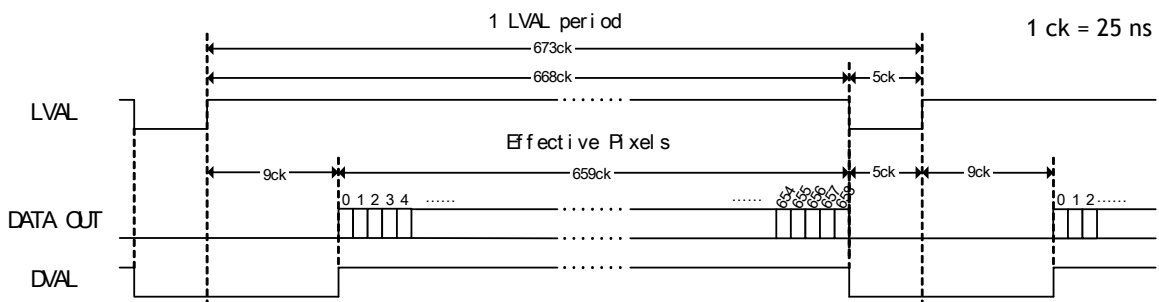


Fig. 15. Horizontal timing

6.2.4. LVAL a-synchronous accumulation

The CV-A33CL has LVAL a-synchronous accumulations only. The accumulation will start 28 μsec . after the trigger leading edge. EEN will indicate the accumulation time. When the accumulation stops after the selected shutter time, the LVAL phase is reset and restarted.

1 LVAL = 16.825 μsec .

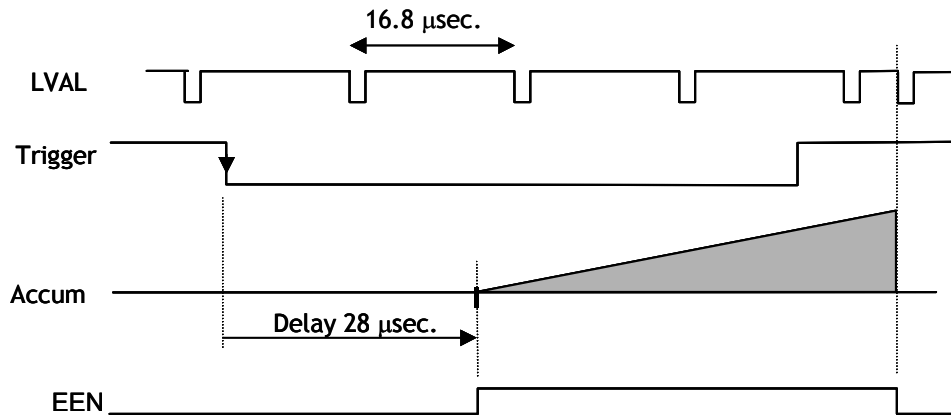


Fig. 16. LVAL a-synchronous accumulation

In CV-A33 with LVAL a-synchronous accumulation a new trigger can be input and start a new exposure during the previous frame read out. But the exposure may not be finished before the frame is read out. It makes it possible to have a trigger rate close to the frame rate. The minimum trigger interval should be $>(1FVAL + 1 LVAL)$.

6.2.5. Timing for window of interest

With $WS=1$, the X and Y start coordinates (WX and WY), and the width and height (WW and WH) for the window of interest can be programmed with 1 pixel interval. The minimum window size is 2(h) x 3 (v). If the window is specified outside the full image area, it will be placed up to the right or low limit as shown in fig 17. right.

Figures marked with (*) in the timing diagrams below will change with other window settings.

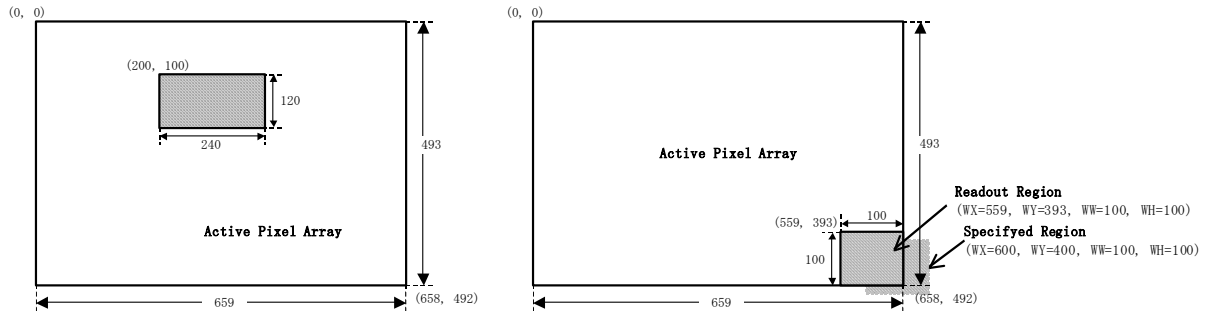


Fig. 17. Window of interest.

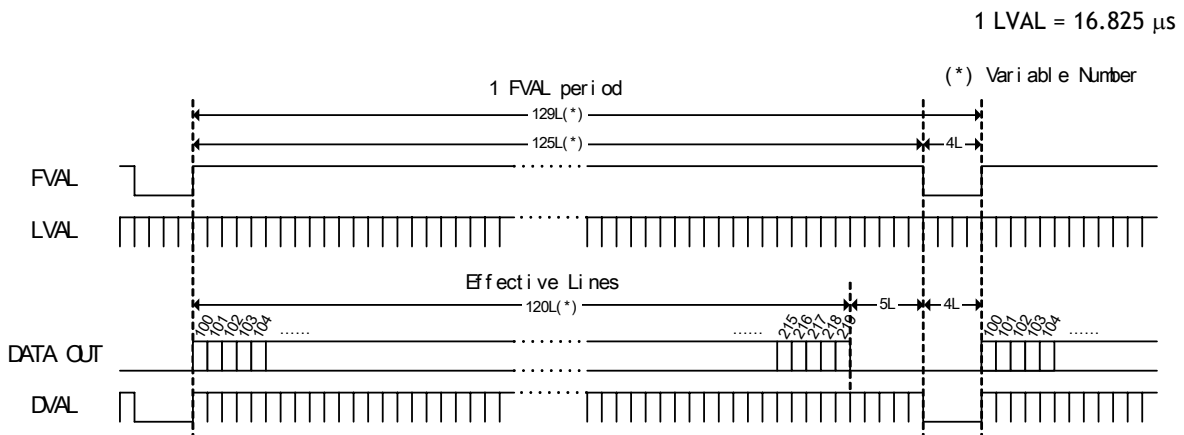


Fig. 18. Vertical timing for window of interest.

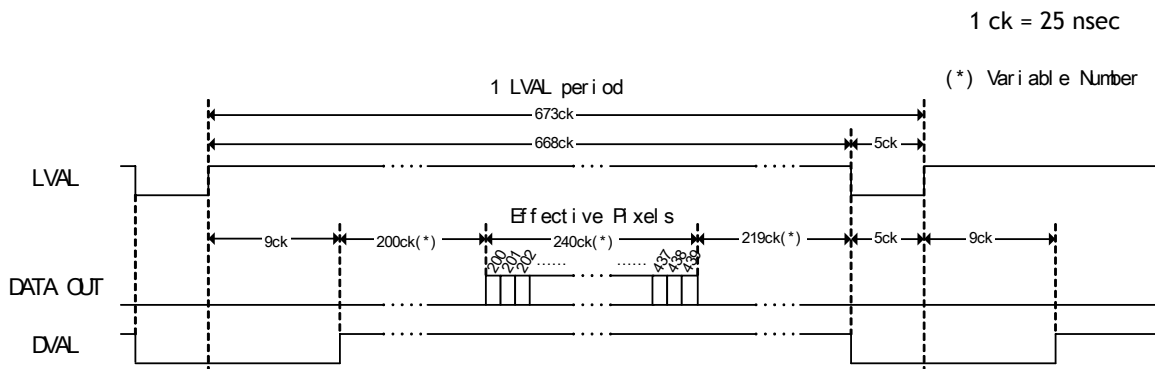


Fig. 19. Horizontal timing for window of interest.

6.3. Input/Output of Timing Signals

6.3.1. Input of Timing Signals

It is not possible to synchronize the camera from an external sync source except by an external trigger pulse. The camera will always run with its internal X-tal controlled timing.

Trigger input through Camera Link. TI=0

Trigger input as TTL on pin #10 on 12 pin Hirose. TI=1

The trigger polarity is active low. TP=0

Trigger input can be changed to active high. TP=1

The trigger input on pin #10 on the 12 pin Hirose connector can be 75 Ω terminated with the internal switch SW 300-1 ON.

6.3.2. Output of Timing Signals

To synchronize the video data transfer from the camera the following signals are available in a base configuration of Camera Link:

FVAL	Frame valid	High for valid Frame
LVAL	Line valid	High for valid line
PCLK	Pixel clock	
DVAL	Data valid	High for valid data
EEN	Exposure enable	Low during exposure

See the full connector pin assignment for Camera Link in chapter 5.3 and 5.4.5

For complete documentation on the Camera Link standard, please contact your JAI distributor.

EEN is also found as a TTL signal on pin #9 on the 12 pin Hirose. EEN is low during exposure.

6.4. Trigger Modes

This camera can operate in 4 primary modes. 1 non-triggered, 2 external asynchronous trigger modes and auto trigger mode.

- | | | |
|----|---------------------------------------|-------------------------------------|
| 1. | <i>Normal continuous Mode. TR=0</i> | Pre-selected exposure. (SM=0, SM=1) |
| 2. | <i>Edge Pre-select Mode. TR=1</i> | Pre-selected exposure. (SM=0, SM=1) |
| 3. | <i>Pulse Width Control Mode. TR=2</i> | Pulse width controlled exposure. |
| 4. | <i>Auto Trigger Mode. TR=3</i> | >3 line window, <5404 fps |

In normal continuous mode (TR=0) and edge pre-select mode (TR=1) the shutter time can be selected from the normal 8 fixed steps (SM=0), or it can be selected from the 2 to 493 steps programmable (SM=1). In programmable exposure the actual exposure is 1 LVAL less than the PE value.

The trigger pulse width should be >1 LVAL to <3 FVAL. (>16.8 μ sec. to <25 msec.)

In pulse width control (TR=2) the trigger pulse width should be >1 LVAL to <237 FVAL. (>16.8 μ sec. to <2 sec.)

Windows of interest (WS=1) can be used in normal, edge pre-select and pulse width control mode. (TR=0, TR=1 and TR=2).

6.4.1. Continuous Operation (Non triggered)

Mode settings can be done with RS-232C. Trigger Mode Normal. TR=0. It is for applications where the camera is continuous running without external trigger. The shutter mode can be normal or programmable exposure. (SM=0, SM=1). The shutter will work in all 8 steps up to 1/20,000 second or with the programmable exposure in 2 to 493 steps. In programmable exposure the actual exposure is 1 LVAL less than the PE value.

In windows scan (WS=1), shutter times longer than the actual frame time have no meaning. The exposure will be equal the frame time.

To use this mode:

Set function:	Trigger mode "Normal"	TR=0
	Shutter mode "Normal" or "Programmable"	SM=0, SM=1
	"Shutter Speed"	SH=0 through 7
	"Programmable exposure"	PE=2 through 493
	"Windows" "Full" or "Windows scan"	WS=0, WS=1
	Polarity and other functions	

Important notes on using this mode.

- The line at the end of the exposure period (SM=0, SM=1) will have a slightly lower signal level. (About 10%). It is caused by the CMOS. (With SH=1/250 the line is seen in the middle of the image).

For timing refer to 6.2.2. and 6.2.3. Fig. 14. and fig 15.

For windows scan timing refer to 6.2.5 and fig.17 through fig.19.

6.4.2. Edge Pre-select Mode

The exposure will start 28 μ sec. after the trigger leading edge, and it stops and is read out after the shutter time selected. It can be the 8 steps in normal or 2 to 493 steps in programmable. SM=0 or SM=1. In programmable exposure the actual exposure is 1 LVAL less than the PE value. This mode will operate with full window or windows of interest scanning.

An EEN pulse will indicate the active accumulation time, and a FVAL pulse indicates that the resulting video is read out.

To use this mode:

Set function:	Trigger mode "Edge Pre-select"	TR=1
	Shutter mode "Normal" or "Programmable"	SM=0, SM=1
	"Shutter Speed"	SH=0 through 7
	"Programmable exposure"	PE=2 through 493
	"Windows" "Full" or "Windows scan"	WS=0, WS=1
	Polarity and other functions	
Input:	Ext. trigger to Camera Link or pin 10 on 12-pin connector.	

Important notes on using this mode.

- The duration of the trigger should be >1 LVAL to <3 FVAL. (>16.8 μ sec. to <25 msec.)
- A new trigger can be applied before FVAL is low as long as the exposure will be on for longer than the FVAL high period. Refer to 6.2.4

For timing refer to 6.2.2. and 6.2.3. Fig. 14. and fig 15.

For windows scan timing refer to 6.2.5 and fig.17 through fig.19.

For LVAL a-synchronous accumulation refer to 6.2.4 and fig 16.

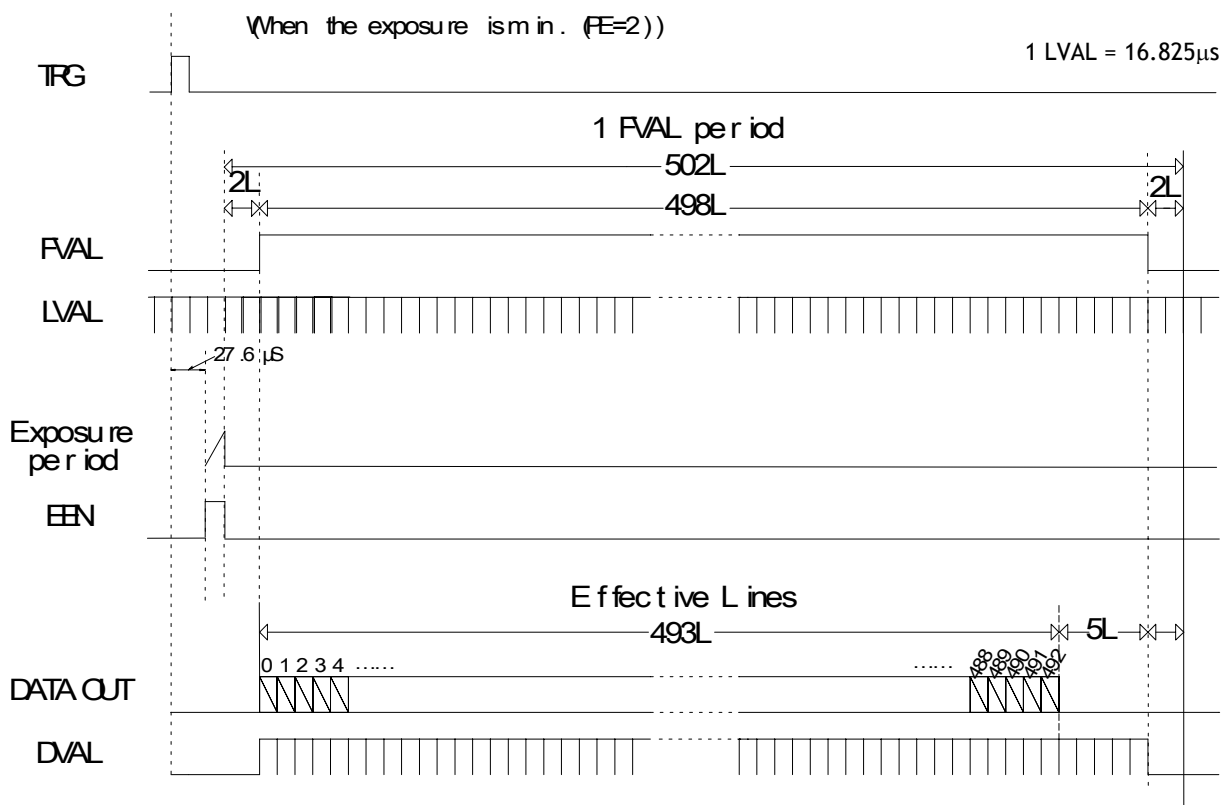


Fig. 20. Vertical timing for edge pre-select min. exposure

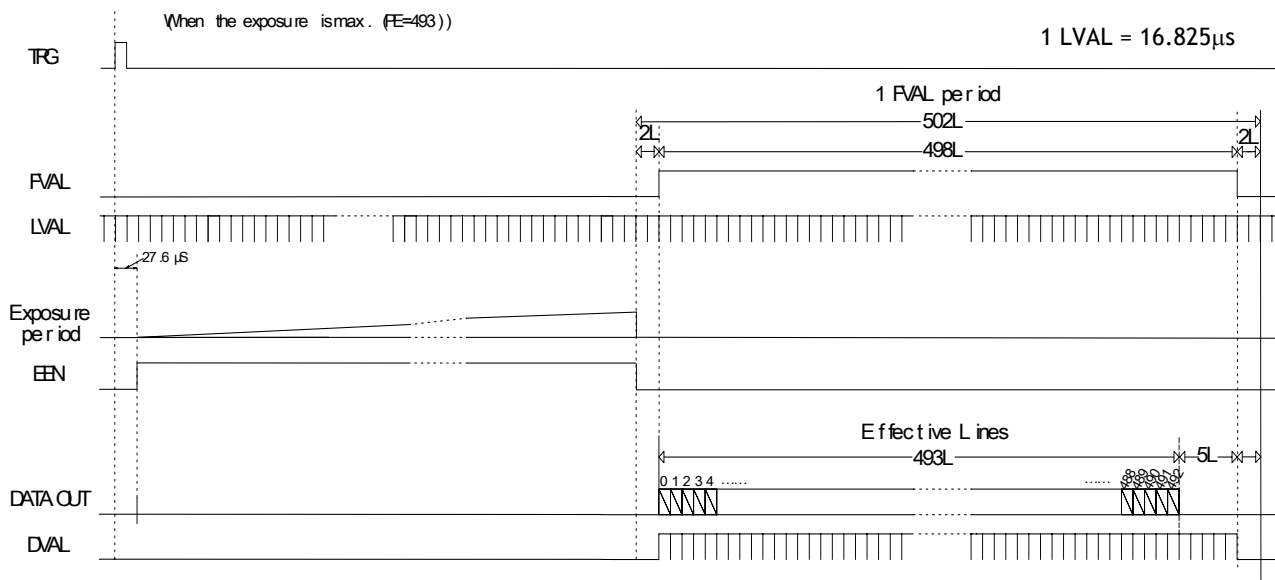


Fig. 21. Vertical timing for edge pre-select max. exposure

6.4.3. Pulse Width Control Mode

The exposure will start 28 μ sec. after the trigger leading edge, and it stops and is read out at the trigger trailing edge. This mode will operate with full window or windows of interest scanning.

An EEN pulse will indicate the active accumulation time, and a FVAL pulse indicates that the resulting video is read out.

To use this mode:

Set function: Trigger mode "Pulse Width Control" TR=2
 "Windows" "Full" or "Windows scan" WS=0, WS=1
 Polarity and other functions
 Input: Ext. trigger to Camera Link or pin 10 on 12-pin connector.

Important notes on using this mode.

- The duration of the trigger should be >1 LVAL to <237 FVAL. (>16.8 μ sec. to <2.0sec.) The image quality can be reduced at maximum pulse width.
- A new trigger can be applied before FVAL is low as long as the exposure will be on for longer than the FVAL high period. Refer to 6.2.4

For timing refer to 6.2.2. and 6.2.3. Fig. 14. and fig 15.

For windows scan timing refer to 6.2.5 and fig.17 through fig.19.

For LVAL a-synchronous accumulation refer to 6.2.4 and fig 16.

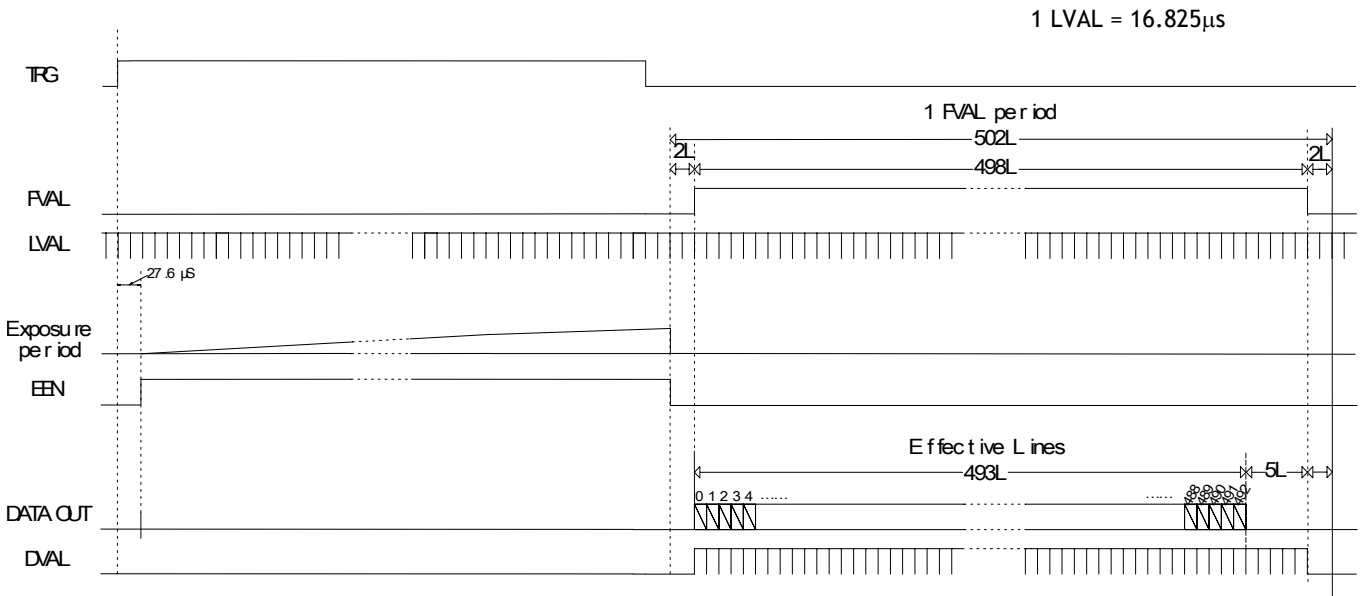


Fig. 22. Vertical timing for pulse width control min. exposure

6.4.4. Auto trigger Mode

The auto trigger function, TR=3 can be used as sensing device inside the camera field of view. It sense in a programmable window from top of the image. The continuous output is sent to the frame grabber, which PC should be programmed to sense if an object is passing the window. The horizontal position and the signal threshold could be the programmed parameters. If an object passing is detected, a trigger is send to the camera. The resulting image, a full frame or windows scan, (depending of windows scan setting), is read out to the grabber, and the auto trigger function with fast scan of the programmed window will start again.

To use this mode:

Set function:	Trigger mode "Auto Trigger Mode"	TR=3
	"Auto Trigger"	AT=3 through 493
	"Windows" "Full" or "windows scan"	WS=0, WS=1
	Polarity and other functions	

PC and grabber: Detect trigger conditions
Send a pulse width control trigger to the camera.

Input: Ext. trigger to Camera Link or pin #10 on 12-pin connector.

Important notes on using this mode.

- The exposure is equal the programmable parameter AT.
- The exposure time is the same for the auto trigger partial scanned frame and the resulting triggered frame read out.
- The duration of the trigger should be $>1 \text{ LVAL}$ to $<1 \text{ FVAL}$. ($>16.8 \mu\text{sec.}$ to $<8.3 \text{ msec.}$)
- Refer to 6.1.7. Auto Trigger Window of Interest.
- Max auto trigger frame rate is 5403 fps.

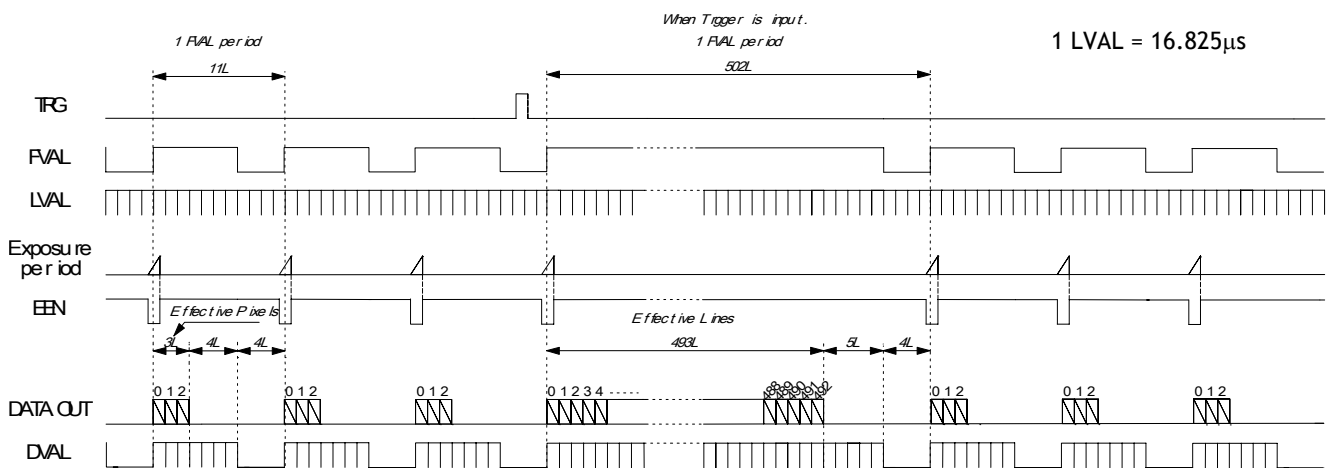


Fig. 23. Vertical timing for auto trigger function

6.5. Other Functions.

User ID.

The command (UD) the user can save up to 16 characters in the camera to identify the camera.

Bit Allocation.

The command (BA) will select the number of bits in the Camera Link output to 8 or 10 bit.

Black Level.

The command (BL) is for adjusting the video black level (or set-up level).

GAin level.

The command (GA) is for adjusting the gain level between 0 and 15 dB.

Calibration of CMOS sensor.

This command (CB=0) will calibrate all the A/D converters on the CMOS sensor. The calibration procedure for gain and offset is done automatically each time the command is received and at power up. Allow the camera to warm up before the calibration is done.

The data from the calibration can be stored in a file by the camera control tool by the command "Read Calibration" and "Write to File". With the command "Read from File" the calibration data can be loaded to the camera and used as calibration.

Important notes on using this function.

- "Read Calibration" takes about 22 seconds.
- "Read from File" takes about 45 seconds.

7. Configuring the Camera

7.1. Switch setting inside

SW 200 is for selecting the RS232C input through Camera Link or the 12 pin HR connector.

SW 200 is placed inside on the camera motherboard PK8387B near the rear.

SW 300 is for 75 Ω terminating of the trigger input on pin #10 on 12 pin HR connector.

SW 300 is placed inside on the rear board PK8388B. (On for 75 Ω terminating.)

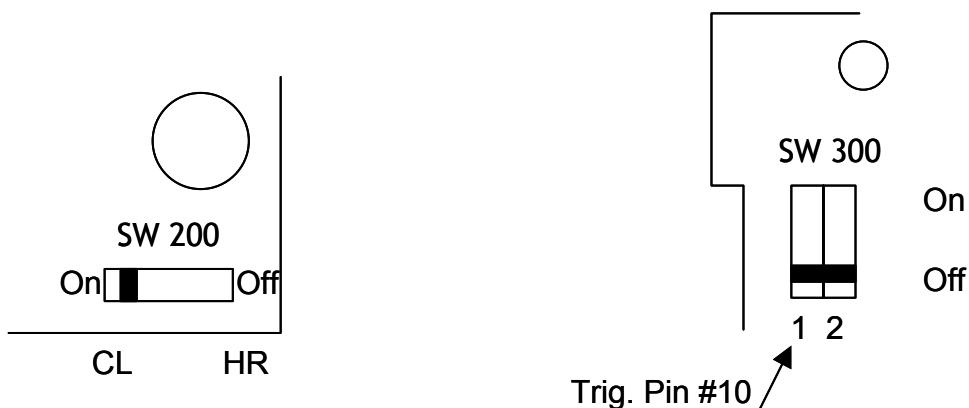


Fig. 24. Internal switch setting

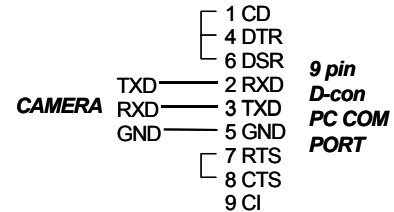
7.2. RS-232C control

All configuration of the CV-A33CL camera is done via the RS-232C port on the 12 pin HR connector or via Camera Link. (Internal switch SW200 off for HR). The camera can be set up from a PC running terminal emulator software, or using JAI's camera control software. Below is the description of the ASCII based short command protocol.

Communication setting.

Baud Rate	9600 bps
Data Length	8 bit
Start Bit	1 bit
Stop Bit	1 bit
Parity	None
Xon/Xoff Control	None

RS 232C cable



Protocol.

Transmit setting to camera:

NN=[Parameter]<CR><LF> (NN is any kind of command. Capital or small letters.)

The camera answers:

COMPLETE<CR><LF>

To have all communication visible on the emulator screen, start with:

EB=1<CR><LF>

The camera answers:

COMPLETE<CR><LF>

Transmit request command to camera:

NN?<CR><LF> (NN is any kind of command.)

The camera answers:

NN=[Parameter]<CR><LF>

Transmit the following to have the camera actual setting:

ST?<CR><LF>

The camera answers:

A complete list of the current settings

Transmit the following to have a command list:

HP?<CR><LF>

The camera answers:

A list with all commands and possible settings

Invalid parameters send to camera: (99 is an invalid parameter)

SH=99<CR><LF>

The camera answers:

02 Bad Parameters!!<CR><LF>

To see firmware number.

VN?<CR><LF>

To see camera ID. It shows the manufacturing lot number.

ID?<CR><LF>

7.3. CV-A33CL command list

	Command Name	Format	Parameter	Remarks
A - General settings and useful commands				
EB	Echo Back	EB=[Param.]<CR><LF>	0=Echo off 1=Echo on	Off at power up
ST	Camera Status request	ST?<CR><LF>		Actual setting
HP	Online Help request	HP?<CR><LF>		Command list
VN	Firmware version	VN?<CR><LF>		3 letter version
ID	Camera ID request	ID?<CR><LF>		10 characters
MD	Model Name request	MD?<CR><LF>		≤ 10 characters
UD	User ID (Free text)	TR=[Param.]<CR><LF>	User can save and load free text	≤ 16 characters
B - Video Output				
BA	Output bit allocation	BA=[Param.]<CR><LF>	0=10 bit 1=8 bit	Camera Link
C - Timing and shutter related commands				
WS	Windows Scan	WS=[Param.]<CR><LF>	0=full frame 1=windows scan	
WX	X Scan start coordinate	WX=[Param.]<CR><LF>	0-657	Start pixel #
WY	Y Scan start coordinate	WY=[Param.]<CR><LF>	0-490	Start line#
WW	X Scan size width	WW=[Param.]<CR><LF>	2-659	Window width
WH	Y Scan size height	WH=[Param.]<CR><LF>	3 - 493	Window height
AT	Auto Trigger	AT=[Param.]<CR><LF>	3-493	*) Wind. 3H to 493H
TR	Trigger mode	TR=[Param.]<CR><LF>	0=normal 1=Edge pre-sel 2=Pulse width 3=Auto Trigger	
SM	Shutter mode	SM=[Param.]<CR><LF>	0=Normal 1=Program. exp	
SH	Shutter speed	SH=[Param.]<CR><LF>	0=Off (1/120) 1=1/250 2=1/500 3=1/1000 4=1/2000 5=1/5000 6=1/10000 7=1/20000	All 8 steps are valid in normal trigger mode.
PE	Programmable expos.	PE=[Param.]<CR><LF>	2-493	Exp. 1H to 492H H= 16.8μsec
D- Signals and polarity				
LS	LVAL synchronous accum.	LS=[Param.]<CR><LF>	0= LVAL sync. 1= LVAL a-sync.	*1) Only a-sync.
TI	Trigger Input	TI=[Param.]<CR><LF>	0= CamerLink 1= 12 pin Hiror	
TP	Trigger polarity	TP=[Param.]<CR><LF>	0= active low 1= active high	*2)
E - Gain and analogue signals setting				
BL	Black level	BL=[Param.]<CR><LF>	0-31 (0=low 31=high)	
GA	Gain level	GA=[Param.]<CR><LF>	1-11 (0=low 11=high)	
CB	Calibration of CMOS sensor	CB=0<CR><LF>	0 is the only allowed parameter	Will calibrate the CMOS sensor
F - Saving and loading data in EEPROM				
LD	Load settings from camera EEPROM	LD=[Param.]<CR><LF>	0=Factory data 1=User 1 area 2=User 2 area	Latest used data default at power up
SA	Save settings to camera EEPROM	SA=[Param.]<CR><LF>	1=User 1 area 2=User 2 area	Parameter = 0 is not allowed

*) Auto trigger window will always start from top. Max frame rate with AT=3. It is 2 LVAL exposure + 9 LVAL offset.

*1) The command LS is found on the first cameras. Only LS=1 is will work correct.

*2) If positive logic is used (TP=1), the first trigger pulse after power up will be ignored. TTL only.

!! Do not try to use commands not shown in this list.

7.4. Camera Control Tool for CV-A33

From www.jai.com Camera Control Tool for Windows 98/NT/2000 can be downloaded. The control tool contains a camera control program and tools for making your own program. For the integrator and experienced user, the Camera Control Tool is much more than a program with a window interface. It also provides an easy and efficient ActiveX interface built for MS Windows 98, ME, NT and 2000. The OCX interface has the ability to connect to the camera using the serial interface of the PC by reading and writing properties for the camera. This integration requires simple programming skills within Visual Basic, Visual C++ or similar languages in a Microsoft Windows environment.

Below the different windows are shown.

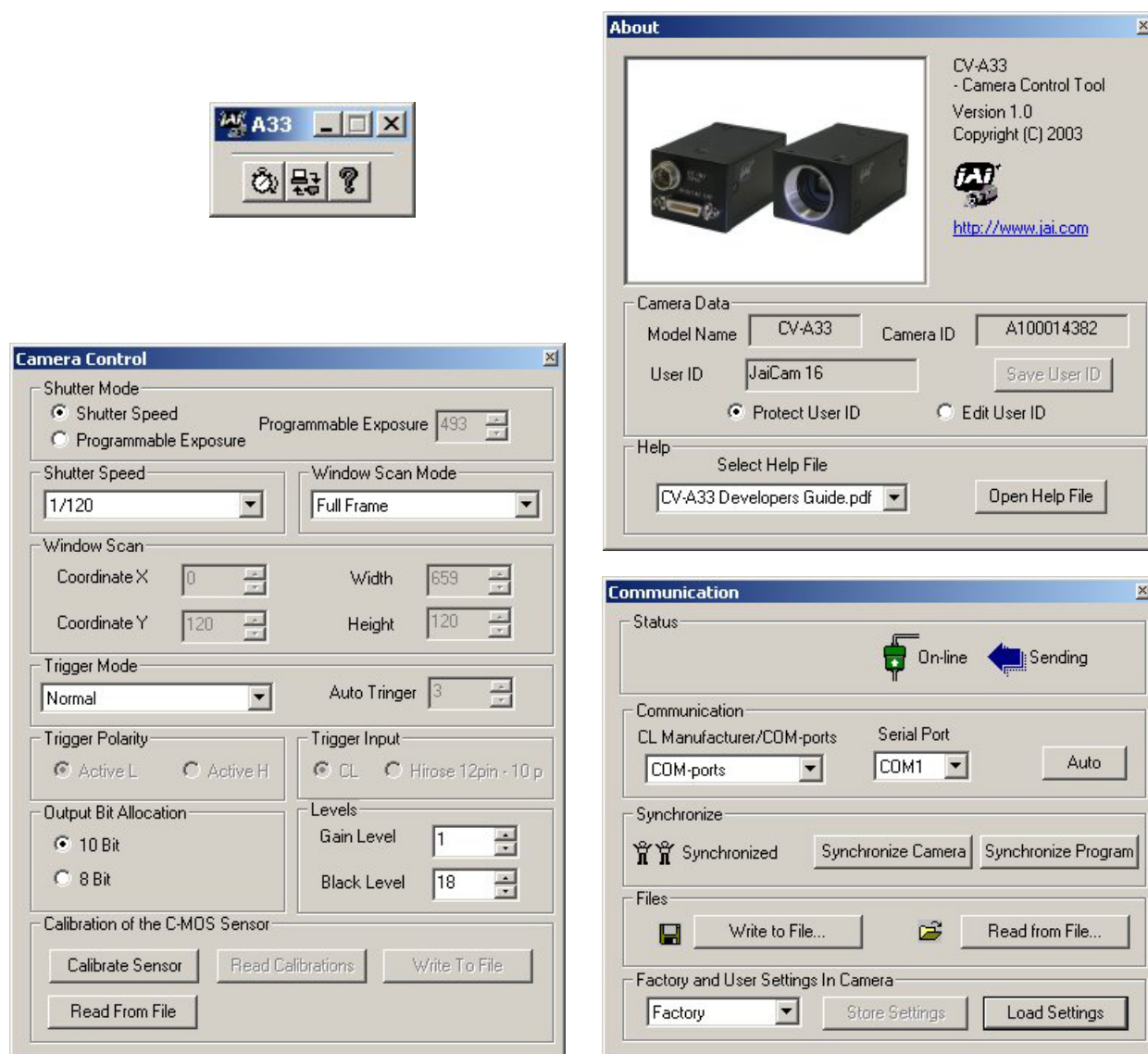


Fig. 25. Window from camera control tool

8. External Appearance and Dimensions

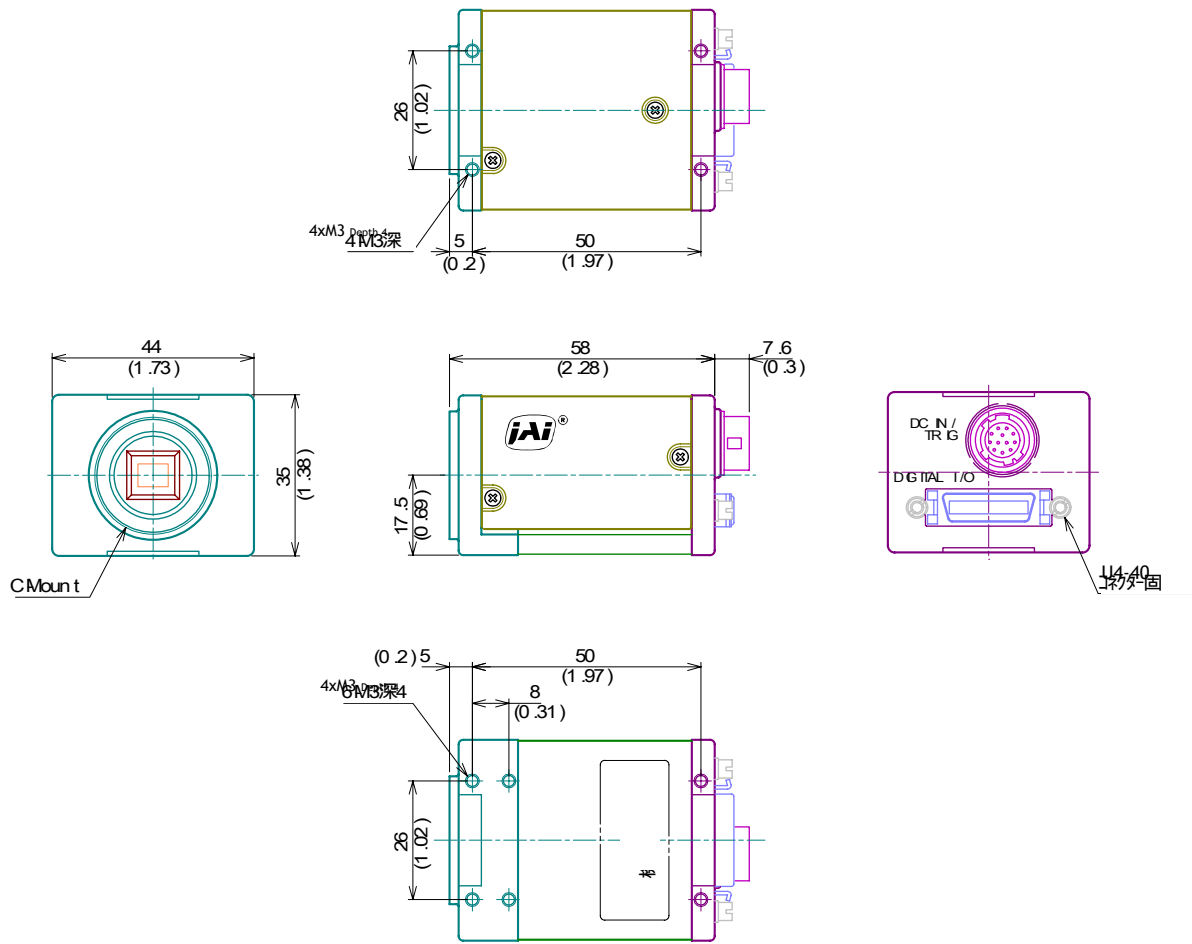


Fig. 26. Outline.

9. Specifications

9.1. Spectral sensitivity

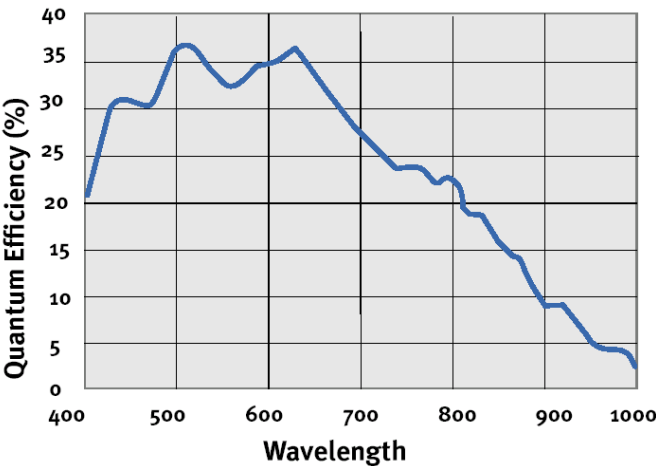


Fig. 27. Spectral sensitivity for CV-A33

9.2. Specification table

Specifications	CV-A33CL
Scanning system	Progressive scan
Pixel clock	40.000 MHz (25 nsec)
Line frequency	59.44 kHz (673 pixels clock/line) (16.825 μ sec)
Frame rate	118.4 frames/sec. (502 lines/frame) (8.44615 msec)
CCD sensor	1/2" progressive scan monochrome CMOS image sensor: Micron MT9V403C12 STM
Sensing area	6.61 (h) x 4.97 (v) mm
Cell size	9.9 (h) x 9.9(v) μ m
Effective pixels	667 (h) x 502 (v)
Pixels in video output Full Window	659 (h) x 493 (v) 118.4 fps >2 (h) x >3 (v)
Max window scan frame rate	<4953 fps. 659 (h) x 3 (v)
Auto trigger sensing rate	<5403 fps. 659 (h) x 3 (v)
Sensitivity on sensor	13 Lux (Min. gain, shutter 1/120, 100% video) 1.2 Lux (Max. gain, shutter 1/120, 50% video)
S/N ratio	>45 dB
Digital video output	10/8 bits in Camera Link
Gain	Remote
Gain range	0 to +15 dB
Synchronization	Int. X-tal. Ext. random trigger
Inputs Camera Link TTL	Ext. trigger Ext. trigger TTL 4 V \pm 2 V. (TTL or 75 Ω terminated)
Outputs Camera Link TTL	Pixel clock, LVAL, FVAL, DVAL, EEN EEN (4 V from 75 Ω)
Control interface	TXD and RXD via RS 232C TDX and RDX via Camera Link
Trigger modes	Continuous, Edge pre-select, Pulse width control, Auto trigger
Accumulation	LVAL a-synchronous
Shutter	Global (simultaneous exposure for all pixels)
Read out modes	Full or Partial as user selectable window of interest
Shutter speed (fixed)	1/120 through 1/20,000 second
Programmable exposure	1 LVAL to 492 LVAL (16.8 μ sec. to 8.3 msec.)
Pulse width control	>1 LVAL to <237 FVAL (>16.8 μ sec. to <2.0 sec.)
Partial readout window of interest	X origin, Y origin, X width, Y height With 1 pixel increment
Functions controlled by RS 232C	Shutter, Trigger, Scanning, Readout, Trigger input, Black level and Gain
Operating temperature	-5°C to +45°C
Humidity	20 - 80% non-condensing
Storage temp/humidity	-25°C to +60°C/20% to 90%
Vibration	10G (20Hz to 200Hz in all directions)
Shock	70G
EMC	CE (EN50081-1 and EN50082-1), FCC part 15, UL94
Power	12V DC \pm 10%. 2.5 W
Lens mount	C-mount (Flange back 17.526 mm \pm 0.05mm) Image centre \pm 0.1mm from C-mount centre
Dimensions	35 x 44 x 58 mm (HxWxD)
Weight	120g

10. Appendix

10.1. Precautions

Personnel not trained in dealing with similar electronic devices should not service this camera. The camera contains components sensitive to electrostatic discharge. The handling of these devices should follow the requirements of electrostatic sensitive components.

Do not attempt to disassemble this camera.

Do not expose this camera to rain or moisture.

Do not face this camera towards the sun, extreme bright light or light reflecting objects.

When this camera is not in use, put the supplied lens cap on the lens mount.

Handle this camera with the maximum care.

Operate this camera only from the type of power source indicated on the camera.

Power off the camera during any modification such as changes of jumper and switch setting.

10.2. Typical Sensor Characteristics

The following effects may be observed on the video monitor screen. They do not indicate any fault of the camera, but do associate with typical sensor characteristics.

V. Aliasing

When the CCD camera captures stripes, straight lines or similar sharp patterns, jagged image on the monitor may appear.

Blemishes

Some pixel defects can occur, but this does not have an effect on the practical operation.

Patterned Noise

When the sensor captures a dark object at high temperature or is used for long time integration, fixed pattern noise may appear on the video monitor screen.

11. Users Record

Camera type:	CV-A33CL
Revision:	(Revision A)
Serial No.
Firmware version.
Camera ID.
Model name.
User ID.

For camera revision history, please contact your local JAI distributor.

Users Mode Settings.

Users Modifications.



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